Aquatic Surveys and Re-assessment of Sites within the Middle Powder River Watershed

Prepared for:

The U.S. Bureau of Land Management - Miles City Field Office

and

The Interagency BLM Aquatic Task Group

Prepared by:

David M. Stagliano
Aquatic Ecologist

Montana Natural Heritage Program
a cooperative program of the
Montana State Library and the University of Montana

May 2012

Aquatic Surveys and Re-assessment of Sites within the Middle Powder River Watershed

Prepared for:
The U.S. Bureau of Land Management - Miles City Field Office
and
The Interagency BLM Aquatic Task Group

Agreement Number:
L08AC13222

Prepared by:
David M. Stagliano
Aquatic Ecologist

P.O. Box 201800 • 1515 East Sixth Avenue • Helena, MT 59620-1800 • 406-444-5354

This document should be cited as follows:

Stagliano, David M. 2012. Aquatic Surveys and Re-assessment of Sites within the Middle Powder River Watershed. Report for the U.S. Bureau of Land Management, Miles City Field Office and The Interagency BLM Aquatic Task Group. Montana Natural Heritage Program, Helena, Montana. 19 pp. plus appendices.

Executive Summary

The project goals of the 2011 Aquatic Surveys and Assessment of the Middle Powder Watershed were to: **1)** revisit five integrator sites established and sampled in 2005 to assess aquatic community changes during this time period; **2)** perform habitat-targeted surveys for the rare sand-dwelling mayfly community; and **3)** interpret key community and watershed indicators (against reference condition standards) to determine aquatic condition status and trends since the development of coalbed natural gas (CBNG) wells in the watershed. Inventory work occurred on BLM lands where possible to enable informed management at the local site scale. Fish and macroinvertebrate samples were collected at six mainstem Powder River sites in Montana (Moorhead Bridge site added in 2011) for this BLM assessment.

Fish Communities: Fish surveys were performed at each site using the 300 m seining protocols developed by Bramblett et al. (2005) for Montana Fish, Wildlife and Parks. Overall, we captured 374 individuals and identified eight native species at the six mainstem Powder River sites. Despite using the same effort during similar river flows, fish numbers and diversity were significantly lower (about 1/4 as many individuals) in 2011 than in 2005, which recorded 1299 individuals of 13 fish species. Native fish species averaged six per site in 2011, whereas in 2005, sites averaged seven per site (7.5 species is Expected {E} at reference condition). Flathead chubs were the dominant members of this river section's fish community in 2011 averaging 66% of the individuals collected, while in 2005 they only made up about 28% with sand shiners dominating the catch (60%). The exotic carp and introduced plains killifish were not collected at any of the 2011 sites where they were reported in 2005. The Sturgeon Chub, a Montana species of concern previously common in this reach, was not collected in 2011 and only at one downstream site in 2005, indicating a sustained decline or absence in this reach. Fish communities across all sites scored relatively lower with the IBI and Observed vs. Expected (O/E) in 2011 than in 2005 (averaging 54.8 vs. 58.4 and 0.8 vs. 0.9, respectively), but these differences were not significant (F-test, $p= 0.25$ and 0.74). The Moorhead Bridge site was the exception for 2011 with increased IBI and O/E scores. When calculating O/E values, four of the six sites scored within the 1.2-0.8 unimpaired/good integrity threshold, while sites POW3 and POW6 ranked impaired with scores of 0.57 and 0.63. The fish community scores did not correlate with the macroinvertebrate DEQ MMI or O/E scores ($r=0.09$ and 0.07), but did have a positive relationship with the BLM Habitat Scores ($r=0.51$ and 0.55).

Macroinvertebrate Communities: Paired EMAP-protocol macroinvertebrate samples were collected at each site replicating efforts from 2005. Overall, 64 total taxa were reported from the sites in 2011, an increase from 59 taxa in 2005. Average macroinvertebrate-taxa richness per site was 28 taxa, which is a significant increase from 23.4 taxa per site reported in 2005 ($p < 0.03$). All EMAP samples agreed in ranking the six Powder River sites non-impaired with DEQ MMI plains-index scores >37 and the O/E, but the O/E scores based on species expected only >50% of the time report all sites significantly below the impairment threshold. Reach-Wide EMAP samples collected two of the five species of rare sand-dwelling mayflies, *Homoeoneuria alleni* and *Anepeorus rusticus* not sampled with the Targeted-Riffle Protocols (Peck et al. 2003). Targeted sampling of the rare sand-dwelling mayfly community with the over-sized dip net proved laborious and ineffective at increasing occurrence records or estimating densities.

There were no discernible trends in the MMI or O/E index scores from the Wyoming Border to Broadus, and MMI scores were not significantly different than 2005 scores. However, the occurrence and abundance of some sensitive/Species of Concern (SOC) mayfly species has significantly decreased from the Wyoming Border to Moorhead Bridge from 2005 to 2011, while the abundance of the stonefly, *Acroneuria abnormis*, has significantly increased across the study area in recent years.

Community Integrity: Multiple lines of evidence (fish and macroinvertebrates) indicate a continued decline in the biological integrity of this reach of the Powder River. This is particularly noted in fish and SOC mayfly species declines between the Wyoming border and Moorhead Bridge. From a long-term perspective, the fish community at the WY border looks significantly different than it did 30 years ago, as it continues to lose sensitive species and biological integrity. Concurrent studies have found that the maximum concentrations of alkalinity in the Powder River also occurred in this reach (Petersen et al. 2011), potentially implicating cumulative effects from coalbed natural gas extraction-related outflows from upstream in Wyoming as likely contributors to this biological condition. Community Integrity results from the 2011 fish and macroinvertebrate surveys combined to rank the Powder River reach at the Moorhead Bridge Site as the most biologically intact, followed by Powder River Site #5 upstream of Rough Creek (POW#5). In 2005, the Powder River reach at the Wyoming border (POW#1) and POW#5 had the highest index of biotic integrity (IBI) for fish. Powder River Site #5 was also the only site where we collected Sturgeon Chubs (Montana SOC) in 2005, but we failed to collect any during the 2011 sampling.

Acknowledgements

We would like to thank The Interagency Aquatic Task Group (ATG) of the Bureau of Land Management (BLM), especially Jake Chaffin of the Miles City Field Office and Bill Ostheimer of Buffalo, Wyoming BLM FO, for support and funding of MTNHP aquatic ecological projects. We also thank Dave Feldman (MTDEQ) for running the 2011 macroinvertebrate O/E models. Dr. Dan Gustafson, provided important information about his research

We wish to thank those who assisted us in the field sampling, including Troy Hinke (Broadus) and Winston Greeley (Helena) of MT-FNP. Substantial on-site field sampling and logistic help were provided by Bryce Maxell (MTNHP). Editorial comments were provided by MTNHP staff members Linda Vance, Gary Carnefix, and Neil Snow. Coburn Currier formatted and provided helpful comments on the report. This is publication no. 2012-03 of the Montana Natural Heritage Program.

Table of Contents

List of Figures

List of Tables

List of Tables (continued)

Introduction

The Powder River is a vast drainage representing one of the last undammed, large prairie rivers in the United States. In this part of southeastern Montana, the landscape through which the Powder flows resembles a natural condition-state of a large prairie river with sweeping meanders across the valley bottom, side channels, oxbows, shifting islands and functional connectedness to the floodplain (Vance et al. 2006). The Powder River aquatic ecosystem supports many elements of a fully functioning, biologically diverse system, including 25 native fish species (19 in Montana) (Baxter and Stone 1995) and numerous species of rare invertebrates. Some mayfly and dragonfly species of concern (SOC), including globally rare (G1-G3) species, have evolved to exploit the shifting sand and gravel bar habitats common in unaltered large prairie rivers (D. Gustafson, pers. comm. 2006, Stagliano 2006, MTNHP and MTFWP 2006). With its specialized aquatic life, the Powder River supports not only a diverse community, but represents the sole remnant of a once widespread Great Plains riverine community of fish and invertebrates (Hubert 1993). The Powder River was identified as the reference standard in the Large Prairie River classification (Stagliano 2006); no other large prairie system in the ecoregion contains the quality and biological integrity of its communities and habitats (Stagliano 2005). Furthermore, the Powder River was determined to provide substantial habitat for the declining sturgeon chub (Montana and Wyoming SOC, BLM Sensitive Species) (Werdon 1992), a species that has been extirpated from much of its historic range (Stagliano and Gould 2010).

The Powder River Basin in Wyoming and Montana is currently undergoing one of the world's largest coalbed natural gas (CBNG) developments, with about 12,000 wells in place in 2003, 14,200 in 2005, and up to 70,000 projected over the next 20 to 30 years (Davis and Bramblett 2006). CBNG mining has the potential to severely disrupt biota in adjacent riparian zones and streams. However, information is scarce concerning the effects of CBNG product water on fish and aquatic invertebrates, making it difficult to predict the potential effects of this development on aquatic ecosystems (Davis et al. 2009). Therefore, pre-development baseline data and monitoring can be used to assess the influence of CBNG wells at the landscape or local reach scale. Despite numerous projects undertaken to document and monitor biological communities in the middle Powder River watershed (Confluence Consulting 2004; Stagliano 2006; Davis et al. 2009; Peterson et al. 2009; Peterson et al. 2011), gaps still exist in our basic knowledge of prairie river aquatic community spatial and temporal changes without the addition of confounding anthropogenic factors (Dodds et al. 2004). Additionally, the Powder River presents numerous challenges in evaluating its biological and chemical integrity. These include problems associated with sampling a shifting sand-bed stream, high variability in flow, and naturally high conductivity and turbidity.

Structural changes have been documented in the fish assemblages since the 1970s in the present study section of the Powder River from dominance by flathead chub (*Platygobio gracilis*) to dominance by sand shiner (*Notropis stramineus*) (Stagliano 2006, Peterson et al. 2010). This change has been coupled with a continued decline of the sturgeon chub (*Macrhybopsis gelida*) throughout the Powder River (Stagliano and Gould 2010) and increased occurrences of introduced fish species (Patton et al. 1998). Therefore, additional monitoring is warranted within the targeted locations between the Wyoming border and Broadus.

This study represents a continued investigation into documenting the fish and macroinvertebrate communities of this prairie river section with these specific objectives: **1)** to revisit and resample six integrator sites established in 2005 to assess aquatic community changes over this time period; **2)** to perform habitat-targeted surveys for the rare sand-dwelling mayfly community; and **3)** to interpret key community and watershed indicators (against reference condition standards) to determine aquatic condition status and trends during the development of CBNG wells in the watershed.

Powder River Study Sites

Joseph Platz (former BLM Miles City Fish Biologist) and I established the following sites in 2005 along the main-stem Powder River on BLM or state-owned riparian parcels that were "two track" accessible and would complement on-going USGS monitoring sites. We keep the initial naming convention of the sites despite dropping site 4 and inserting Site 6 upstream of Site 5. We added the Moorhead Bridge site in 2011 after conversations with Jake Chaffin (BLM Miles City) (Figure 1, Table 1).

Table 1. Powder River Site locations sampled in 2011.

Site Code	Site Description	River Mile	Latitude	Longitude	Elevation	Reach Gradient	Date Sampled
POW1	Powder River near Wyoming border	219	45.0128	-105.9029	3426	0.5%	7/26/2011
POW2	Powder River near Dry Creek	215	45.0377	-105.8809	3376	0.3%	7/26/2011
POWMOOR12	Powder River at Moorhead bridge	212	45.0578	-105.8775	3350	0.4%	7/27/2011
POW3	Powder River downstream from Moorhead	206	45.1071	-105.8421	3315	0.2%	7/27/2011
POW6	Powder River near Buttermilk Creek	187	45.2256	-105.6906	3185	0.2%	7/27/2011
POW5	Powder River near Rough Creek	166	45.3467	-105.5333	3105	0.2%	7/28/2011

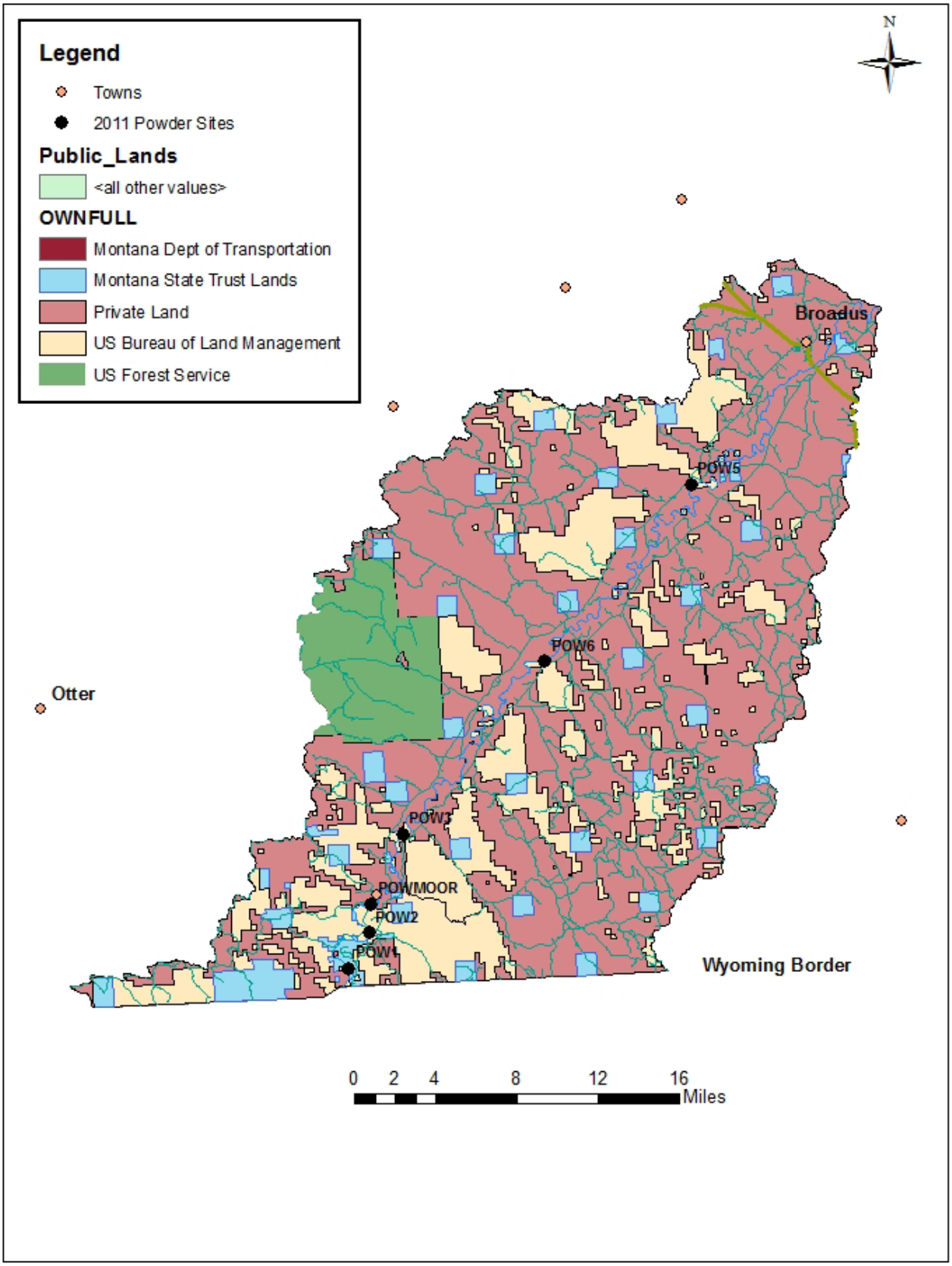

Figure 1. Aquatic Sample sites in the Middle Powder River Watershed.

Methods

Aquatic communities (fish and macroinvertebrates) and riparian areas were inventoried and assessed using a combination of Montana Fish, Wildlife and Parks (MFWP) (fish) and BLM / EPA (macroinvertebrates and habitat assessments) protocols and methodology. These methods replicated those used during our July 2005 site visits during river flows at 500 cfs (recorded at the USGS Moorhead Gaging Station). Reach lengths were set at a standard 300 m, but to encompass an additional set of riffle macrohabitats for the macroinvertebrate targeted-riffle sampling, protocols were extended to 450 m. Information and results from previous inventories, such as those conducted by MTFWP (fish), USGS and BLM (macroinvertebrates), were incorporated into the analysis for Moorhead Bridge (in 2005) and earlier site visits for the Wyoming border site.

Habitat and Water Quality Collection and Analysis

The assessment stream reach was divided into 10 equally spaced transects according to the BLM and EMAP protocols (http://www1.usu.edu/buglab/forms/Bug%20Protocol%20form.pdf; Lazorchak et al. 1998). The downstream transect was marked (GPS, flagging and photo point) as the bottom of the reach. All ecological assessment protocols started from this point and continued upstream for 300 m (designated the assessment area or "AA") to the top of the reach, which was also marked.

Parameters recorded at each transect were: wetted width; three channel depth measurements; percent large woody debris and riparian shading. On-site habitat assessments were conducted using the rapid assessment protocol developed for the EPA by Barbour et al. (1999), with modifications for the BLM by the National Aquatic Assessment Team (scores 0-24). Water quality measures: Specific conductivity; pH; water temperature; and dissovlved oxygen concentration were measured prior to biological sampling, which used a Yellow Springs Instruments Inc. Model 85 water meter calibrated to the higher conductivity level.

Fish Collection and Analysis

Fish surveys were performed using the 300 m seining protocols developed by Bramblett et al. (2005) for Montana Fish, Wildlife and Parks. This protocol calls for block nets at the upstream and downstream ends of the reach, but the width of the Powder River precluded the use of these. Instead, shallow riffle areas were used as barriers and appeared sufficient in preventing fish from escaping while the run and pool areas were being seined (Figure 2). Shallow riffle areas unable to be seined in the normal fashion because of cobble obstructions were "kick-seined" (Figure 2) to capture fish inhabitating this microhabitat. We used 30 ft, ¼ inch mesh seines to cover most areas across the channel and all macrohabitats within the reach.

Figure 2. Seining the Powder River near the Wyoming border by beach seining (l) and kick-seining a riffle (r).

Fish were transferred to holding buckets, identified to species, enumerated in the field, examined for external anomalies (e.g. deformities, eroded fins, lesions, and tumors), and released. Young-of-the-year fish less than 20 millimeters in length were noted on the field sheet (not included in the totals), and released. Voucher specimens were taken only in the case of uncertain field identifications of the silvery minnows, *Hybognathus* spp., which were preserved in 10% buffered formalin and identified in the lab. Vouchers will be submitted to the Montana State University fish collection. Analysis of the sampled fish communities used Integrated Biotic Indices (IBI) (Bramblett et al. 2005) and derived Observed/Expected (O/E) fish models (Stagliano 2005) to detect impairment or species loss in the biological integrity of the sites. The IBI involved calculation of a series of 10 metrics evaluating different attributes of the fish community (Table 2, Appendix B).

Because fish species richness can be directly proportional to watershed size and is a multiplicative factor in the Montana IBI (Bramblett et al. 2005), we used the average catchment area for this study reach (20,962 km^2) based at the

*Table 2. Characteristics, metrics, and classification of fish captured in the Powder River during 2005 and 2011 sampling. * = species collected in 2005, but not in 2011.*

Species	Scientific Name	Trophic*	Feeding Habitat†	Litho-obligate Reproductive Guild‡	Tol**	Origin††
Hiodontidae						
Goldeye	*Hiodon alosoides*	IN	WC	LO	INT	N
Catostomidae						
River Carpsucker*	*Carpiodes carpio*	OM	BE	LO	MOD	N
Shorthead Redhorse*	*Moxostoma macroledidotum*	IN	BE	LO	MOD	N
Cyprinidae						
Common Carp*	*Cyprinus carpio*	OM	BE		TOL	I
Flathead Chub	*Platygobio gracilis*	IN	GE		MOD	N
Longnose Dace	*Rhinichthys cataractae*	IN	BE	LO	INT	N
Plains Minnow	*Hybognathus placitus*	HB	BE		MOD	N
Western silvery Minnow	*Hybognathus argyritis*	HB	BE		MOD	N
Sand Shiner	*Notropis stramineus*	OM	GE	LO	MOD	N
Sturgeon Chub*	*Macrhybopsis gelida*	IN	BE	LO	INT	N
Cyprinidontidae						
Plains Killifish*	*Fundulus kansae*	OM	GE		TOL	I
Ictaluridae						
Channel Catfish	*Ictalurus punctatus*	IC	BE	TR§	MOD	N
Stonecat	*Noturus flavus*	IC	BE	LO	INT	N

^HB = herbivore (> 90% plants or detritus); IC = invertivore/carnivore (>25% both invertebrates and vertebrates); IN = invertivore; OM =
† BE = benthic; GE = generalist; WC = water column: Brown (1971); Scott and Crossman (1973); Becker (1983)
‡ LO=Litho-obligate Reproductive Guild; Scott and Crossman (1973); Pflieger (1997); Barbour et al. (1999)
§ Tolerant reproductive strategists are not litho-obligates, use parental care at spawning site: Scott and Crossman (1973); Pflieger (1997)
** INT = intolerant; MOD = moderately tolerant: TOL = tolerant; Barbour et al. (1999);
†† N = native; I = introduced; Brown (1971); Holton and Johnson (2003)

Moorhead gauging station for these calculations. The summation of individual fish species and tolerance metrics range between 0 and 100. Bramblett et al. (2005) did not propose threshold criteria for good, fair, and poor biological integrity for these scores, but instead relied on comparisons to "reference condition" scores. Therefore, we followed Confluence Consulting (2004) methods by applying commonly used criteria of 75 to 100 indicating good to excellent biological integrity, 25 to 74 indicated fair biological integrity, and less than 25 indicating poor biological integrity in describing condition.

Derivation of the expected fish communities is performed by identifying the frequency of occurrence that a species has at a site classified in a reference condition and summing the frequencies across all fish species of the community (see Stagliano 2006). The O/E (Observed taxa of an evaluated site/Expected Taxa for a reference site) model is a direct measure of the community completeness. Taxonomic completeness is a fundamental aspect of biological integrity and is defined here as the proportion of the taxa that "should" occur in a sample (E) that were actually sampled (O) (Jessup et al. 2005). It compares the fish species that are expected at a site with the actual taxa that were found when the site was sampled (carp/introduced species are never "expected" and thus were given scores of zero). Values of the O/E range from 0 to 1, with values of 1 implying reference conditions and values less than 1 implying some form of biological impairment. In some cases, it is more ecologically meaningful than the IBI, but not always. Pairs of fish community samples were compared across years for significant differences by using proportional and taxa community similarity indices (Brower and Zar 1984).

Macroinvertebrate Collection and Analysis

The two standardized macroinvertebrate methods used for the mainstem Powder River monitoring were the EMAP Targeted Riffle (8 composited riffle Surber samples, area sampled = 0.744 square meters) and the EMAP Reach-Wide sampling for including all habitats within the sampling reach (10 dipnets, area sampled was ca. 0.93 square meters) (Lazorchak et al. 1998, Peck et al. 2003) (Figure 3).

These samples were collected within the MTDEQ recommended sampling time frame (June 1st- September 15th), preserved in 1 liter Nalgene

Figure 3. Reach-wide EMAP macroinvertebrate sample (F pin center) at Powder River Site 2.

bottles with 95% ethanol and processed (sorting, identification and data analysis) by David Stagliano at the MTNHP Helena lab following protocols used by the BLM Buglab: http://www1.usu.edu/buglab/process/lab%20procedures.htm. Macroinvertebrates were identified to species, counted and the tabular data entered into spreadsheet and database forms. Data analysis included computation of indices of community structure such as proportion of EPT (% Ephemeroptera, Plecoptera and Trichoptera taxa) and other biological metrics used in calculating the MTDEQ multimetric macroinvertebrate (MMI) indices or used in the Observed /Expected (O/E) Models (Jessup et al. 2005, Feldman 2006). Metric results were then scored using the MTDEQ bioassessment criteria and each sample categorized as non-impaired or impaired according to threshold values (Table 3). The macroinvertebrate MMI score is based upon a series of metrics that measure attributes of benthic macroinvertebrate communities regarding condition changes to a stream system (in the form of pollution or pollutants). The invertebrate metrics include: EPT Taxa Richness (Score = EPT richness/14*100): Ephemeroptera, Plecoptera andTrichoptera taxa; Percent Tanypodinae (Score = Percent Tanypodinae/10 *100)[Tanypodinae is a subfamily of Chironomidae]); Percent Orthocladiinae of Chironomidae (Score = (100-percent Orthocladiinae of Chironomidae/100)*100); Predator Taxa Richness (Score = number of predator taxa/9*100); Percent Collectors and Filterers (Score = (100 – percent collectors and filterers/65)*100. The index score represents the condition of the macroinvertebrate community at the time the sample was collected. If the index score is below the impairment threshold, the individual metrics can be used to provide insight as to why the communities are different from the reference condition (Barbour et al. 1999, Jessup et al. 2005). The results from the eastern plains index metrics are averaged to obtain the final index score. The impairment threshold set by MTDEQ is 37 for the eastern plains stream MMI index and <0.8 for the O/E (Table 3). Ideal scores representing a "complete" community are between 0.8 and 1.2 where a score of 1.0 represents 100% of the expected species were actually collected. The O/E scores can be evaluated by summing all taxa expected at a given site (0/E p>0), or by summing only those taxa expected to be at the site greater than 50% of the time (O/E p>0.5). The latter method has been found to eliminate the "eschewing" effect of counting too many rare taxa in the sample (Marchant 2002).

The final invertebrate sampling method targeted main current, sand-dwelling invertebrates with a modified 0.5 meter rectangular dipnet (D. Gustafson, pers. comm. 2006). The dipnet was maneuvered downstream of the sampler in a diagonal fashion as the sampler is kicking both feet across main-current sandbars using a time-distance catch-per-unit-effort (CPUE) measure to standardize across all reaches sampled in the Powder River.

Table 3. Impairment determinations from the DEQ MMI and O/E (RIVPACS) models (taken from Jessup 2005, Feldman 2006).

Ecoregion	RIVPACS	MMI	Impairment Determination
Mountain	≥ 0.8 or ≤ 1.2	≥63	Not impaired
	< 0.8 or > 1.2	<63	Impaired
Low Valley	≥ 0.8 or ≤ 1.2	≥48	Not Impaired
	< 0.8 or > 1.2	<48	Impaired
Eastern Plains	≥ 0.8 or ≤ 1.2	≥37	Not impaired
	< 0.8 or > 1.2	<37	Impaired

Results and Discussion

Habitat and Water Quality Results and Analysis

Powder River Sites 1 and 5 scored highest in habitat quality with the BLM assessment protocols, representing 75% and 80% of the best possible score, respectively (Table 4). Powder Site 5 also had the highest number of recorded channel depths greater than 50 cm, indicating ample deep holding areas for fish. Powder River Site 3 scored lowest in the habitat assessment scores despite having the second highest number of deep channel areas; unfortunately, many of these deep areas had unstable, unconsolidated substrate (silt, fine sand), which is not optimum fish habitat.

Conductivity measurements were calibrated with the USGS field gauge at the Moorhead Bridge site. Reach-wide conductivity values measured in 2011 averaged slightly higher (1225 µs/cm) than in 2005 (1190 µs/cm), but were not significantly different (F-test, $p>0.05$). Temperature increases of >6 degrees C and slight decreases in dissolved O^2 (>1 mg/l) can be seen in the sequence of sites Moorhead Bridge → POW3 →POW6 as they were sampled on 7/27/2011 from the morning hours into the late afternoon (Table 4).

Fish Community Results and Analysis

We captured 374 individuals and identified eight native fish species at the six Powder River sites (Table 5). Despite using the same effort during similar river flows, fish numbers per site and diversity were significantly lower in 2011 than in 2005 (1299 individuals of 13 fish species). Whereas in 2005, sites averaged 7 spp. per site, in 2011 native fish averaged 6 species per site (7.5 species is expected at reference condition). The exotic carp and introduced plains killifish were not collected at any of the 2011 sites where they were reported in 2005, nor were the native shorthead redhorse or river carpsucker (Table 5). The Sturgeon Chub, a Montana and Wyoming species of concern previously common in this reach, was not collected in 2011 and only at one downstream site in 2005, indicating a sustained population decline or absence in this study reach.

Figure 4. Two native catfish species collected in the Powder River, the stonecat (top) and channel catfish (bottom).

Fish communities across all sites scored relatively lower with the IBI and O/E in 2011 than in 2005 (averaging 54.8 vs. 58.4 and 0.8 vs. 0.9, respectively) (Figure 5). However, these differences were not significant (F-test, $p = 0.25$ and 0.74). At the site level, there were substantial decreases in the IBI at sites POW1 and POW5 between 2005 and 2011; the exception to this declining trend was the Moorhead Bridge site, which had a slightly increased IBI and O/E scores (Figure 5). The O/E at four of the six sites scored within the 1.2-0.8 unimpaired/good integrity threshold, while sites POW3 and POW6 ranked impaired with scores of 0.53 and 0.67 (Table 5, Figure 5).

Table 4. BLM Habitat Quality scores (out of 24), physical and water quality parameters of Powder River sites. ChD =channel depths measured in 10 cross sections (n=30), # of ChD >50cm reflects deep run or pool areas. Cond= Conductivity in microsiemens/cm, DO = Dissolved Oxygen in mg/l.*

Site	BLM Site Score	Avg wetted width (m)	Avg ChD (cm)	# ChD >50 cm	H2O Temp (°C)	pH	Cond*	DO
Powder River 1	18	42.4	36.0	6	23.3	8.5	1180	8.0
Powder River 2	16	38.5	40.0	8	24.5	8.4	1160	7.8
Powder MOOR12	17	37.0	45.0	11	22.7	8.5	1180	8.2
Powder River 3	16	44.0	44.0	15	27.7	8.6	1210	7.8
Powder River 6	15	45.0	32.0	7	28.5	8.4	1302	7.0
Powder River 5	20	42.0	41.0	15	23.4	8.4	1320	9.0

*Table 5. Fish collected from the Powder River sites in 2011. Fish IBI and O/E index scores. * = species collected in 2005, but not in 2011.*

Powder River	Site 1	Site 2	Moor12	Site 3	Site 6	Site 5
River Mile	219	215.4	212.2	206.6	186.9	166.2
Collection date:	7/26/11	7/26/11	7/27/11	7/27/11	7/27/11	7/28/11
Channel Catfish	3	2	1	4	0	1
Common Carp*	0	0	0	0	0	0
Flathead Chub	38	22	28	40	52	59
Goldeye	0	0	3	3	0	3
Longnose Dace	1	1	3	0	2	1
Plains Minnow	2	2	9	0	1	3
Plains Killifish*	0	0	0	0	0	0
River Carpsucker*	0	0	0	0	0	0
Sand Shiner	4	2	3	8	15	37
Shorthead Redhorse*	0	0	0	0	0	0
Stonecat	0	0	2	0	0	0
Sturgeon Chub*	0	0	0	0	0	0
Western Silvery Minnow	3	1	6	0	3	6
Total # species	6	6	8	4	5	7
Native Species	6	6	8	4	5	7
Total Individuals	51	30	55	55	73	110
Fish IBI	51.9	53.5	57.6	53.9	51.4	57.6
O/E	0.80	0.80	1.07	0.53	0.67	0.93

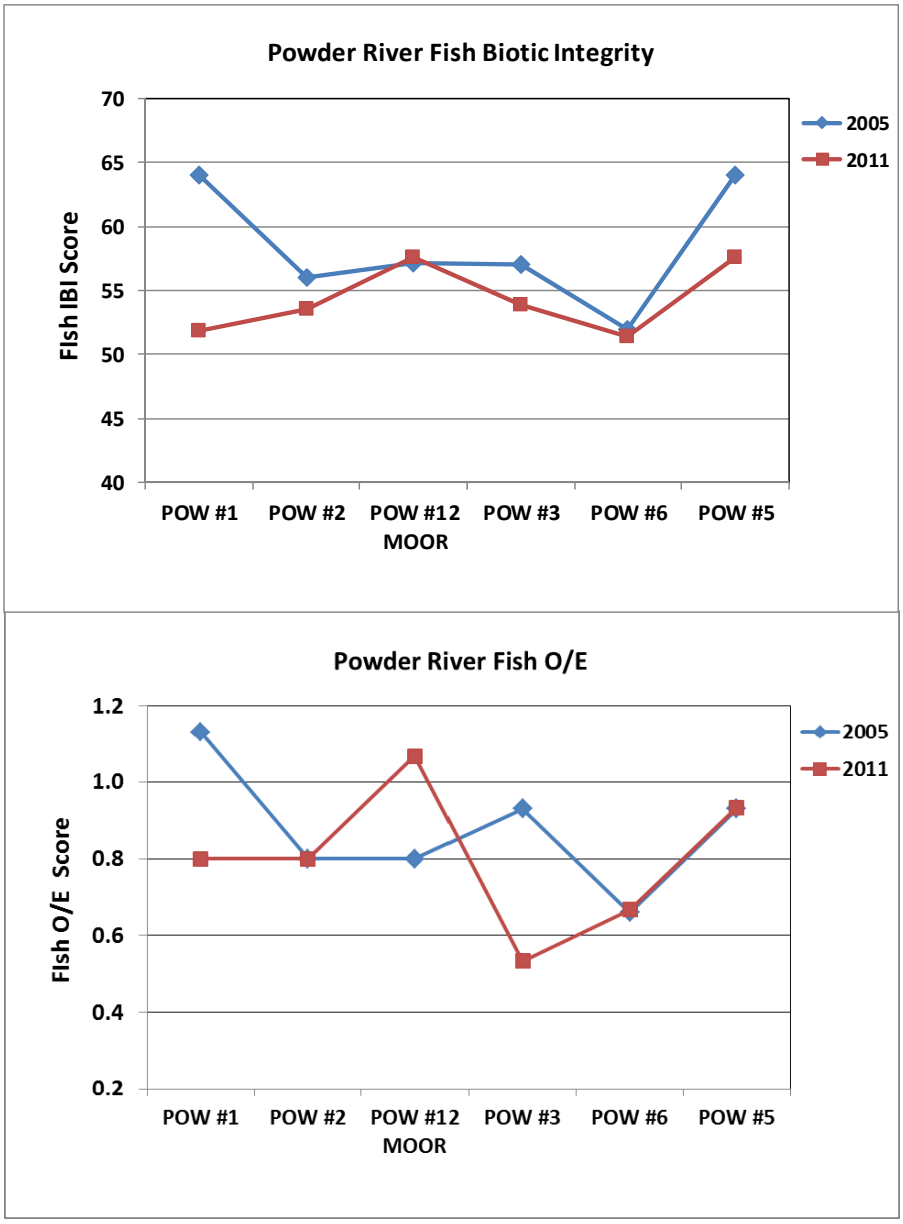

Figure 5. Powder River study reach fish community IBI (top) and Observed/ Expected (O/E) (bottom) Scores for 2005 and 2011.

Flathead chubs dominated the community composition across all sites in 2011 (avg. 66% of individuals), representing a complete shift from the sand shiner dominated assemblages of 2005 and 2008 (Stagliano 2006, Peterson et al. 2009) (Figure 6). These data do not support the recent hypthesis that the switch in dominance to the sand shiner community was linked to a decrease in water quality. More likely, this shift was caused by spatial or temporal variability in fish communities per reach. In addition, overall decreases in the abundance of longnose dace in 2011, which are intolerant of poor water quality, lends some support to this conclusion. In contrast, an increase in the percent of western and silvery plains minnows in the catch in 2011 is a positive indicator of water quality because these species are also considered less tolerant to water quality changes, but the low numbers of total fish per site that we derived these percentages from is still troubling.

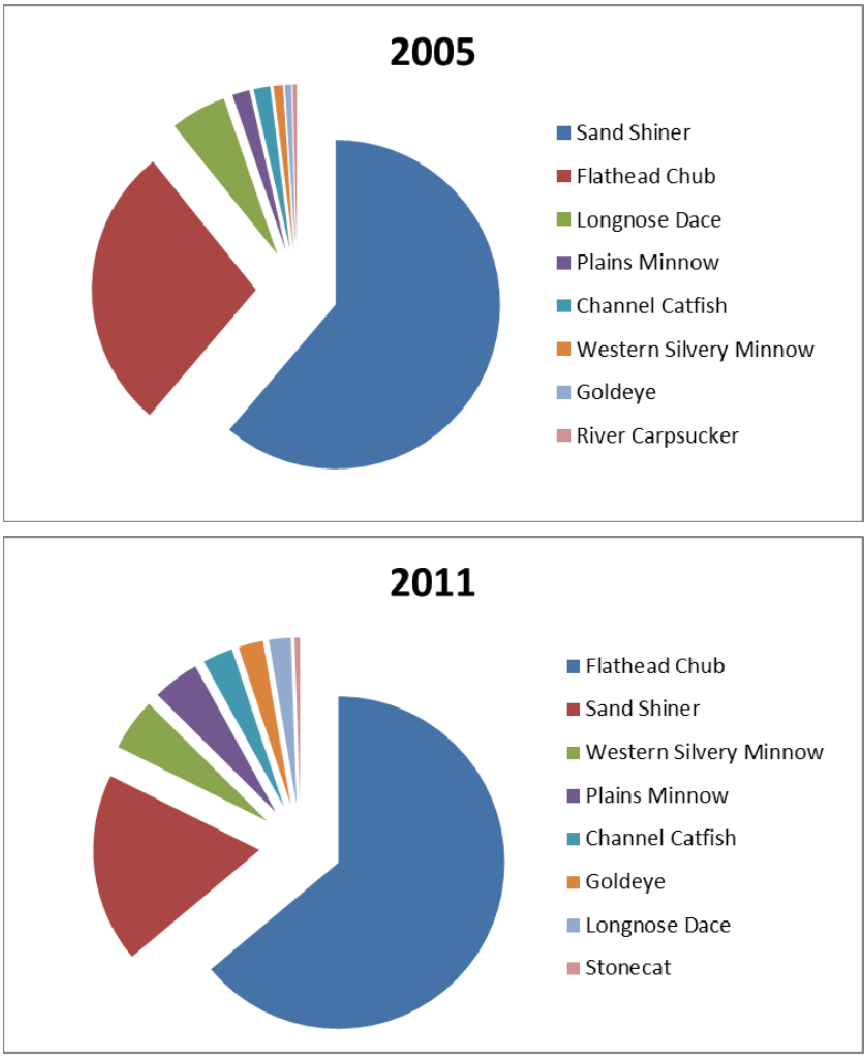

Figure 6. Powder River study reach fish community proportion for the dominant 8 species by total individuals in 2005 (top) and 20011 (bottom).

Relative utility of Fish IBI vs. O/E

Although the fish IBI is inadequate to determine the fish community integrity, it is a useful tool for monitoring sites between years, and it correlated strongly with the habitat quality index ($r=0.451$, $p<0.05$). Fish IBI values ranked all Powder River sites as having fair biological integrity (scores >25 and <75). Even when Powder River sites had their full fish community present (POW5 in 2005), they still ranked only "fair" in biointegrity with the IBI (Figure 5). This can be explained in part because the lowest-scoring metrics were those with adjustments for catchment area, such as number of native species and number of native families. The Powder River is a diverse aquatic system, but one cannot expect a linear increase in fish species with increasing watershed area. For example, to bring the IBI to over 70, a sample of all 20 native species in the Powder River with no tolerant individuals would be required. This situation brings into question the suitabilty of the IBI to a watershed of this size. The largest catchment area of sites used by Bramblett et al. (2005) in developing the fish IBI was about 14,000 km^2 while catchment areas for our sites on the Powder River ranged from about 20,000km^2 to well over 23,000 km^2. By extrapolating beyond the range of the calibration data, we risk serious prediction errors. By using the O/E model as a direct measure of community completeness, the highest expected score in the

upper Powder River reaches, despite a total species pool of approximately 20 species, is 7.5 native species.

A comparsion of diversity levels in the Powder River along the Wyoming border (POW1 at river mile 219) in 1975, 2005, and 2011 indicates that the number of native species and O/E declined during that 36 year interval (Table 6). We can also document that the Percent Community Similarity to 1975 is very low at 24.6% (2005) and 34.6% (2011). But more surprisingly, the taxa similarity between 1975/2005 and 1975/2011 was 58.3% and 33.3% (respectively). Compared to sampling in 1975, of the 12 species not shared with the 1975 sample, five were collected in 2005 and eight in 2011 (Table 6). Taxa similarity between 2005 and 2011 was 62.5%. In addition, two common taxa collected in 1975, lake and sturgeon chubs, which were absent from the 2005 and 2011 samples, were not observed in 2011. Moreover, sturgeon chubs have not been collected within 30 miles of this site in the past five years

Macroinvertebrate Community Analysis

Whereas 59 taxa were reported in 2005, 64 taxa were recorded in 2011 (Appendix C). Average macroinvertebrate taxa richness per site was 28.0 taxa, reflecting a significant increase from 23.4 reported in 2005 (F-test, $p < 0.03$) (Table 7). All EMAP samples agreed in ranking the six Powder River sites as non-impaired,with the DEQ MMI plains indesx score >37 and the OP/E p>0. However, the 0/E p>0.5 scores reflect sites below the expected number of species and below the impairment threshold (Figure 7). The two protocols also yielded different community composition measures, and the within-site sampling method variability was greater than

*Table 6. Powder River fish samples taken 30 and 36 years apart at the Wyoming border (POW 1). * = species not collected at this site in 2005 or 2011.*

Taxa	10/15/1975	7/11/2005	7/26/2011
Channel Catfish	1	3	3
Common Carp*	4	0	0
Goldeye	10	3	0
Longnose Dace	3	3	1
Flathead Chub	965	96	38
Lake Chub*	33	0	0
River Carpsucker	3	1	0
Sturgeon Chub*	25	0	0
Sand Shiner	5	305	4
Shorthead Redhorse	7	1	0
Sauger*	1	0	0
Western Silvery/Plains Minnow	0	12	5
Total Native Species	**10**	**8**	**6**
O/E	**1.27**	**1.13**	**0.80**
% Community Similarity		**24.6%**	**34.6%**
Taxa Similarity		**58.3%**	**2005- 62.5% 1975- 33.3%**

similar-method across site variability. The number of individuals obtained in a targeted riffle (TR) sample was significantly higher than the reach-wide (RW) EMAP samples (F-test, $p<0.001$). All TR samples had to be sub-sampled to reduce the number of organisms for the targeted 600 count, whereas three of the RW samples failed to reach 600 organisms after picking 100% of the sample (Table 7).

Reach-Wide EMAP samples did collect two of the five species of rare sand-dwelling mayflies, *Anepeorus rusticus* (G2S1) and *Homoeoneuria alleni* (G4S2), which were not sampled with the Targeted-Riffle Protocols (Table 8). The number of sites where four SOC taxa were collected has increased by ten since 2005. They were not detected at only four sites where they had been encountered in 2005 (Table 8). Unfortunately for one SOC mayfly taxon, *Raptoheptagenia cruentata*, significant population declines are occurring despite only being "lost" from one site in 2011 (Figure 7, Table 8). In contrast, one of only two stonefly species, *Acroneuria abnormis*, has increased in both population density and site occupancy from 2005 to 2011 (Figure 7). Six other "sensitive" taxa followed similar trends of being detected at more sites in 2011 than being lost (not detected) from sites occupied in 2005, including new "additions" to the study reach by a stonefly taxon, *Isoperla*, and a sensitive Tipulid dipteran (Table 8). Extensive time/distance sampling of sandbar habitat at three sites did not add any additional SOC taxa to the species list or obtain sufficient numbers of individuals to estimate densities per area of stream bottom (Table 9). These sandbar taxa are truly rare with randomized clumped distributions, making it even harder to estimate population size or densities per unit river bottom. However, randomization of the EMAP RW sampling scheme (right, left, center) appeared to provide a reasonably good probablity of detection, as addtional taxa were not found at the three sandbar sites where extensive sampling occurred (Table 9).

Previous investigations from 1999 through 2002 by Dan Gustafson (pers. comm., 2006) and a subsequent study (Staligano 2006) suggest the mayflies are not only rare, but may been already

Table 7. EMAP macroinvertebrate results: T R=Targeted Riffle, RW=Reach-wide. % Sub=percent of sample picked, # Ind= number of individuals picked from subsample. EPT=Ephemeroptera, Plecoptera, and Trichoptera taxa in sample, TTaxa= total taxa richness, number of individuals in the sample, multimetric index score, and aquatic impairment status for stream site.

Site	Site_code	EMAP Method	% Sub Picked	# Ind	TTaxa	EPT Taxa	MMI	Status
Powder River 1	YL_SPW1	TR-500	25	632	26	21	53.5	Non-Impaired
Powder River 1	YL_SPW1Q	RW-500	100	561	37	25	49.6	Non-Impaired
Powder River 2	YL_SPW2	TR-500	50	629	26	17	56.0	Non-Impaired
Powder River 2	YL_SPW2Q	RW-500	100	618	34	21	51.4	Non-Impaired
Powder River Moorhead	YL_SPWM	TR-500	25	603	28	18	56.9	Non-Impaired
Powder River Moorhead	YL_SPWMQ	RW-500	50	607	31	18	51.4	Non-Impaired
Powder River 3	YL_SPW3	TR-500	33.3	558	28	19	59.1	Non-Impaired
Powder River 3	YL_SPW3Q	RW-500	100	385	25	16	46.1	Non-Impaired
Powder River 6	YL_SPW6	TR-500	50	631	26	17	54.5	Non-Impaired
Powder River 6	YL_SPW6Q	RW-500	50	603	28	17	51.9	Non-Impaired
Powder River 5	YL_SPW5	TR-500	50	603	25	17	58.7	Non-Impaired
Powder River 5	YL_SPW5Q	RW-500	100	394	22	13	46.5	Non-Impaired

Table 8. Sensitive and SOC macroinvertebrate species site occupancy changes from 2005-2011: X = collected during both years; (+) = detected in 2011, but not in 2005; (-) = detected in 2005, but not in 2011; blank= not collected at site. TolVal = MT DEQ Tolerance Rank (0, most sensitive), NS Rank = NatureServe Conservation Ranks (see Appendix A).

Sensitive Species	Tol. Value	MT SOC	NS Rank	POW1	POW2	POW Moor	POW3	POW6	POW5
Acroneuria abnormis (P)	0			X	X	X	(+)	X	X
Anepeorus rusticus (E)	1	x	G2S1	(+)	(-)				(+)
Brachycentrus occidentalis (T)	1			X	X	X	(+)	X	(+)
Dicranota (D)	0			(+)	(+)				
Leucrocuta (E)	1			X	X	X	X	(+)	X
Homoeoneuria alleni (E)	2	x	G4S2		X	(+)	(+)	(+)	X
Isoperla (P)	2						(+)	(+)	
*Raptoheptagenia cruentata**(E)	1	x	G4S2	X	X		X	X	(-)
Rhithrogena (E)	0			(+)	(+)	X	(+)	(+)	
Stylurus intricatus (O)	2	x	G4S1	(-)	(-)	(+)		X	

E = Ephemeroptera, P = Plecoptera, T= Trichoptera, O= Odonata

*Table 9. Number of sand-dwelling SOC individuals collected with the EMAP Reach-wide (RW) vs. Sandbar Timed Kick (SB Kick) at three sites with sampling effort. * = not an SOC, but collected with both sampling methods.*

	POW Moorhead		POW3		POW6	
SOC Species	EMAP RW 0.93 m^2	SB Kick 3.0 m^2	EMAP RW 0.93 m^2	SB Kick 3.5 m^2	EMAP RW 0.93 m^2	SB Kick 6.0 m^2
Anepeorus rusticus (E)	0	0	0	0	0	0
Analetris eximia (E)	0	0	0	0	0	0
Homoeoneuria alleni (E)	1	2	3	1	19	5
Lachlania saskatchewanensis[1] (E)	0	0	0	0	0	0
*Ophiogomphus severus** (O)	4	3	1	4	3	1
Stylurus intricatus (O)	1	1	0	0	1	2

[1]Potential Species of Concern

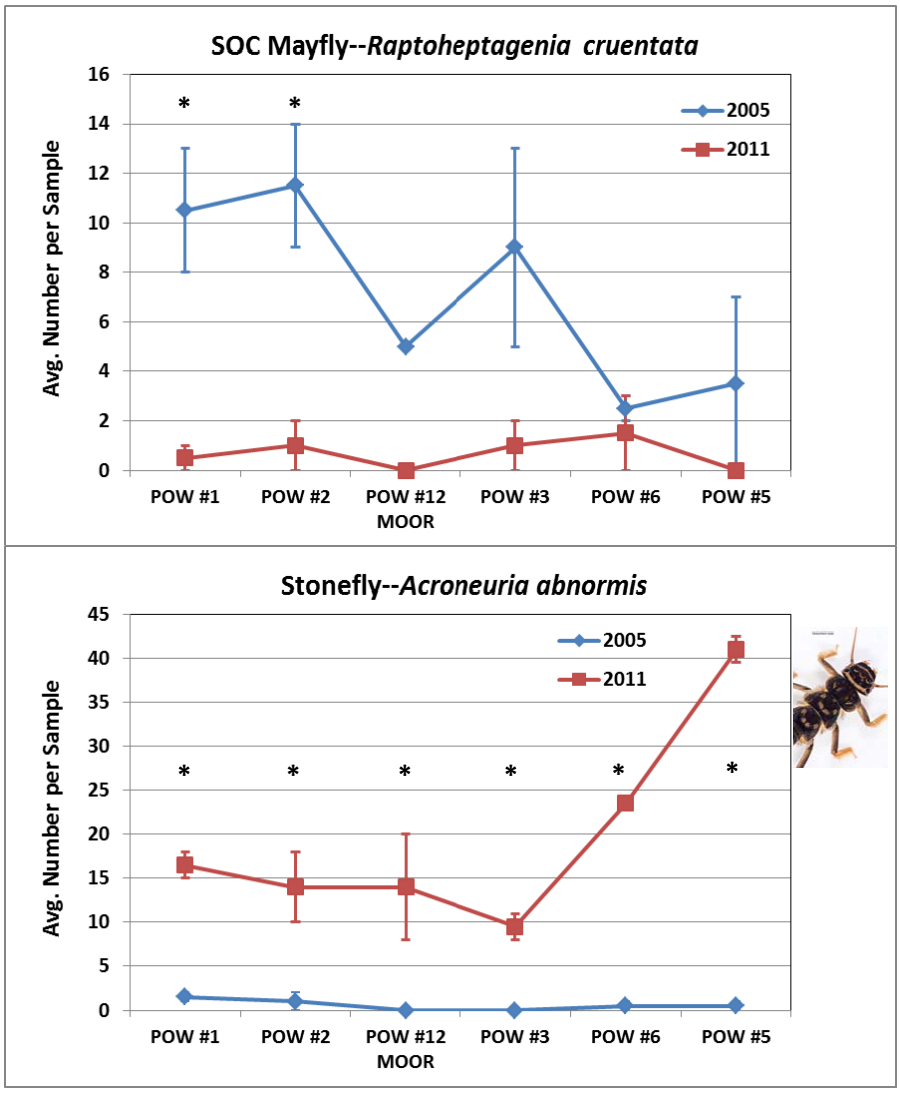

*Figure 7. Individual species responses across sites and years of the SOC mayfly (top) and golden stonefly (bottom). * = significant difference between years (t-test, $p<0.05$). Bars reflected indicate 1 standard error.*

in serious decline. These species once may have been quite common in prairie rivers across the northern Great Plains, but have been eliminated throughout most of their historic range due to impoundments and other anthropogenic river alterations. Unfortunately, inadequate pre-CBNG baseline data on sand-dwelling invertebrates in the Powder River following standardized bioassessment sampling (response of J. Frelich to Powder River EIS [Stagliano 2006]), prevents knowing more accurately the long-term trends of specialized mayflies (Stagliano 2006, Petersen et al. 2010). Although we targeted these species in 2011 with specialized collecting techniques to serve as baseline population estimates for future monitoring, the current absence of many taxa collected previously throughout the study reach suggests that options for helping to conserve the species may be limited.

Macroinvertebrate IBI vs. O/E

No discernible trends were evident in macroinvertebrate MMI index or $O/E_{p>0.5}$ scores from the Wyoming Border to Broadus (Figure 8) and MMI scores in 2011 were not significantly different from 2005 (F-test, $p > 0.05$) (Figure 8). Proceeding downstream the O/E $p>0$ had a slight

decreasing trend and showed more variability in the upper sites by the Wyoming border (Figure 8). As measured by the MTDEQ plains MMI and O/E model in 2011, the biological condition for all assessed Powder River sites, except POW5Q (O/E), was nonimpaired, as it was in 2005 (Figure 8). However, as measured by the O/E p>0.5, all samples fell below the impairment threshold, indicating a signficant departure (i.e., taxa loss or replacement) from expected biological community conditions (Figure 8). But when applying the $O/E_{p>0.5}$ all samples fall below the impairment threshold indicating a significant departure (ie. taxa loss or replacement) from expected biological community conditions (Figure 8). Selected site patterns in biological condition observed in 2005 were repeated in 2011 with appreciable increases in the MMI scores at sites POW2 and POWMOOR and decreases in integrity at POW1 and POW5 (Figure 8).

Although all sites ranked unimpaired with MMI, there was a ca. 20-point scoring spread between the lowest MMI score of 46.5 (2011, POW5 RW) and 65.4 (2005, POW5 RW). Thus, site POW5 (RW) had the most severe macrinvertebrate community integrity decline between years, although it should be noted that RW samples are always more variable than targeted Riffles (Figure 8).

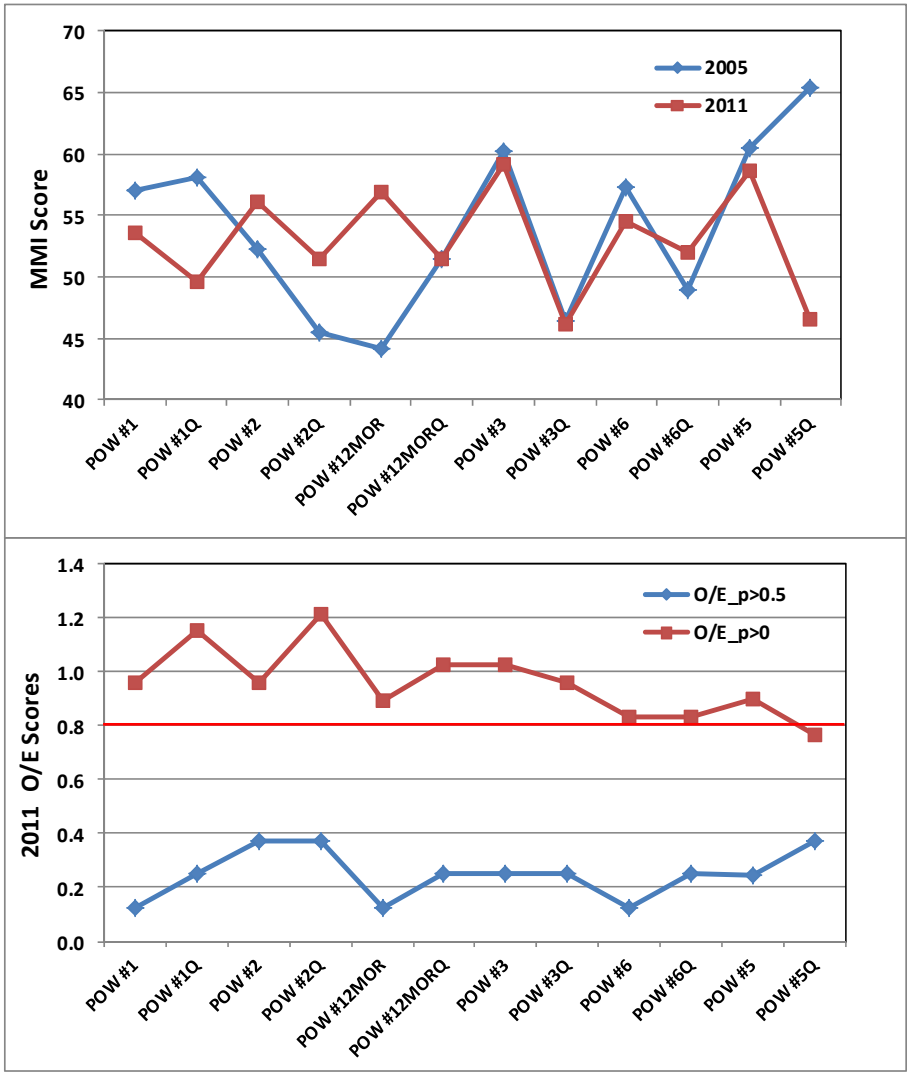

Figure 8. Powder River study reach macroinvertebrate MMI for 2005 and 2011 (top) and Observed/Expected (O/E p>0, O/E p>0.5) Scores for 2011 (bottom). Horizontal red line is the impairment threshold.

Conclusions and Recommendations

The following conclusions and recommendations are offered based on results from surveys:

1. All study sites in the Powder River ranked unimpaired with the DEQ MMI and O/E $_{p>0}$, but by incorporating the fish IBI, O/E, macroinvertebrate O/E $_{p>0.5}$ and individual sensitive species responses, a clearer picture of biological integrity is probably realized. Fish O/E analysis ranked Sites 3 and 6 as biologically impaired and Site 1 was on the impairment threshold with greatly reduced scores compared to 2005. Community Integrity results from the 2011 fish and macroinvertebrate surveys combined to rank the Powder River reach at the Moorhead Bridge Site as the most biologically intact, followed by Powder River Site 5 upstream of Rough Creek.

2. Results from macroinvertebrate samples demonstrated that the EMAP Targeted Riffle protocols sample more insects, track the fish O/E more closely, and have less variability when applied in the field compared to other protocols. Therefore, we recommend replicated EMAP Targeted-Riffle Protocols for future monitoring efforts, while continuing to evaluate multi-habitat protocols, such as the EMAP reach-wide for collecting the rare, SOC sand-dwelling group.

3. The fish community at the Wyoming border has changed significantly over the past three decades, and continues to lose sensitive species and biological integrity. For example, sturgeon chubs have significantly declined or are now absent in the study reach from the Wyoming Border to Moorhead Bridge and potentially further downstream. Patton et al. (1998) found sturgeon chubs at half of the eight sites sampled in the Wyoming portions of the Powder River near Montana. Confluence Consulting (2004) found two sturgeon chubs in 2002 at only one Wyoming site close to the Montana border, and three years later MTNHP (Stagliano 2006) and the USGS (2005) did not capture a single sturgeon chub within 40 miles of the Wyoming border despite combined sampling of 6 stream reaches. The rarity of the sturgeon chub in this reach is alarming for a river that has provided substantial habitat for this species in the past. We recommend additional fish surveys downstream near Broadus to find the new upstream distributional extent of this species. Additional studies that test the tolerance to water chemistry changes in sturgeon chub and other native fish species could be a component of futuring monitoring for CBNG development in the Powder River basin.

Literature Cited

Barbour, M., J. Gerritsen, B.D. Snyder, and J.B. 1999. Rapid Bioassessment Protocols for Use in Streams and Wadable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. United States Environmental Protection Agency; Office of Water: Washington, D.C.

Baxter, G.T. and M.D. Stone. 1995. Fishes of Wyoming. Wyoming Game and Fish Department, Cheyenne, WY.

Becker, G. C. 1983. Fishes of Wisconsin. University of Wisconsin Press, Madison

Bramblett, R.G., T.R. Johnson, A.V. Zale, and D. Heggem. 2005. Development and evaluation of a fish assemblage index of biotic integrity for northwestern great plains. Transactions of the American Fisheries Society 134:624-640.

Brower, J.E. and J.H. Zar. 1984. Field and Laboratory Methods for General Ecology (2nd Ed.). Wm. C. Brown Publishers. Dubuque, IA.

Brown, C. J. D. 1971. Fishes of Montana. Big Sky Books, Montana State University, Bozeman.

Confluence Consulting. 2004. Powder River Biological Survey and Implications for Coalbed Methane Development. Prepared for Powder River Basin Resource Council. 67 pp. + appendices.

Davis, W. and B. Bramblett. 2006. Effects of Coalbed Natural Gas Development on Fish Assemblages in the Powder River Basin. Montana Cooperative Fishery Research Unit Fact Sheet, Montana State University. 3pp.

Dodds, W.K., K. Gido, M.R. Whiles, K.M. Fritz, and W. J. Matthews. 2004. Life on the edge: The ecology of Great Plains prairie streams. BioScience 54: 205-216.

Feldman, D. 2006. Interpretation of New Macroinvertebrate Models by WQPB. Draft Report. Montana Department of Environmental Quality, Planning Prevention and Assistance Division, Water Quality Planning Bureau, Water Quality Standards Section. 1520 E. 6th Avenue, Helena, MT 59620. 14 pp.

Holton, G.D. and H.E. Johnson. 2003. A field guide to Montana fishes, 3rd edition. Montana Fish, Wildlife, and Parks, Helena.

Hubert, W.A. 1993. The Powder River: a relatively pristine stream on the Great Plains. *In*: Restoration Planning for Rivers of the Mississippi Ecosystem. US National Biological Survey Biological Report 19.

Jessup, B., J. Stribling, and C. Hawkins. 2005. Biological indicators of stream condition in Montana using macroinvertebrates. Tetra Tech, Inc. Report to MT DEQ.

Lazorchak, J.M., D.J. Klemm, and D.V. Peck (editors). 1998. Environmental Monitoring and Assessment Program - Surface Waters: Field Operations and Methods for Measuring the Ecological Condition of Wadeable Streams. EPA/620/R-94/004F. U.S. Environmental Protection Agency, Washington, D.C.

Marchant, R. 2002. Do rare species have any place in multivariate analysis for bioassessment? Journal of the NA Benthological Society 21:311-313.

MTNHP and MTFWP 2006. Montana Natural Heritage Program and Montana Fish Wildlife and Parks. Montana animal species of concern. Helena, MT: MTNHP and MTFWP 11p.http://mtnhp.org/Reports/2006_MASOC.pdf

Patton, T.M, F.J. Rahel, and W.A. Hubert. 1998. Using historical data to assess changes in Wyoming's fish fauna. Conservation Biology 12:1120-1128.

Peck, D.V., J.M. Lazorchak, and D.J. Klemm (eds.), 2003. Environmental Monitoring and Assessment Program – surface waters: Western Pilot Study field operations manual for wadeable streams: Washington, D.C., U.S. Environmental Protection Agency, 258 pp.

Peterson, D.A., M.L. Clark, K. Foster, P.R. Wright, and G.K. Boughton. 2010. Assessment of ecological conditions and potential effects of water produced from coalbed natural gas development on biological communities in streams of the Powder River structural basin, Wyoming and Montana, 2005–08: U.S. Geological Survey Scientific Investigations Report 2010–5124, 84 pp.

Peterson, D.A., E.G. Hargett, and D.L. Feldman. 2011. Assessment of potential effects of water produced from coalbed natural gas development on macroinvertebrate and algal communities in the Powder River and Tongue River, Wyoming and Montana, 2010: U.S. Geological Survey Open-File Report 2011–1294, 34 pp.

Pflieger, W. L. 1997. The fishes of Missouri, revised edition. Missouri Department of Conservation, Jefferson City.

Rehwinkel, B.J. 1978. Powder River aquatic ecology report. Report prepared for Utah International, Inc. Montana Department of Fish and Game.

Scott, W. B., and E. J. Crossman. 1973. Freshwater fishes of Canada. Fisheries Research Board of Canada, Bulletin 184, Ottawa

Stagliano, D.M. and W.M. Gould. 2010. Montana AFS Species of Special Concern Status Pages. http://www.fisheries.org/units/AFSmontana/SturgeonChub.html

Stagliano, D.M. 2005. Aquatic Community Classification and Ecosystem Diversity in Montana's Missouri River Watershed. Report to the Bureau of Land Management. Montana Natural Heritage Program, Helena, MT. 65 pp. plus appendices. http://mtnhp.org/Reports.asp?key=1

Stagliano, D. 2006. Aquatic surveys and assessment within the Middle Powder River watershed: Report to the U.S. Bureau of Land Management (ESA010009), 37 pp. http://mtnhp.org/Reports/Mid_Powd_Riv_Water_Assess.pdf

Vance, L., D. Stagliano, and G.M. Kudray. 2006. Watershed Assessment of the Middle Powder Subbasin, Montana. A report to the Bureau of Land Management, Montana State Office. Montana Natural Heritage Program, Helena, MT. 61 pp. plus appendices.

Werdon, S.J. 1992. Population status and characteristics of *Macrhybopsis gelida*, *Platygobio gracilis* and *Rhinichthys cataractae* in the Missouri River Basin. South Dakota State University, Brookings, SD. M.S. Thesis, 55pp.

Appendix A. Global/State Rank Definitions

Heritage Program Ranks

The international network of Natural Heritage Programs employs a standardized ranking system to denote global (range-wide) and state status. Species are assigned numeric ranks ranging from 1 to 5, reflecting the relative degree to which they are "at-risk". Rank definitions are given below. A number of factors are considered in assigning ranks — the number, size and distribution of known "occurrences" or populations, population trends (if known), habitat sensitivity, and threat. Factors in a species' life history that make it especially vulnerable are also considered (e.g., dependence on a specific pollinator).

Global Rank Definitions (NatureServe 2003)

G1	Critically imperiled because of extreme rarity and/or other factors making it highly vulnerable to extinction
G2	Imperiled because of rarity and/or other factors making it vulnerable to extinction
G3	Vulnerable because of rarity or restricted range and/or other factors, even though it may be abundant at some of its locations
G4	Apparently secure, though it may be quite rare in parts of its range, especially at the periphery
G5	Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery
T1-5	**Infraspecific Taxon** (trinomial) —The status of infraspecific taxa (subspecies or varieties) are indicated by a "T-rank" following the species' global rank

State Rank Definitions

S1	At high risk because of extremely limited and potentially declining numbers, extent and/or habitat, making it highly vulnerable to extirpation in the state
S2	At risk because of very limited and potentially declining numbers, extent and/or habitat, making it vulnerable to extirpation in the state
S3	Potentially at risk because of limited and potentially declining numbers, extent and/or habitat, even though it may be abundant in some areas
S4	Uncommon but not rare (although it may be rare in parts of its range), and usually widespread. Apparently not vulnerable in most of its range, but possibly cause for long-term concern
S5	Common, widespread, and abundant (although it may be rare in parts of its range). Not vulnerable in most of its range

Combination Ranks

G#G# or S#S# **Range Rank**—A numeric range rank (e.g., G2G3) used to indicate uncertainty about the exact status of a taxon

Qualifiers

NR	Not ranked
Q	**Questionable taxonomy that may reduce conservation priority**—Distinctiveness of this entity as a taxon at the current level is questionable; resolution of this uncertainty may result in change from a species to a subspecies or hybrid, or inclusion of this taxon in another taxon, with the resulting taxon having a lower-priority (numerically higher) conservation status rank

X **Presumed Extinct**—Species believed to be extinct throughout its range. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered

H **Possibly Extinct**—Species known from only historical occurrences, but may never-the-less still be extant; further searching needed

U **Unrankable**—Species currently unrankable due to lack of information or due to substantially conflicting information about status or trends

HYB **Hybrid**—Entity not ranked because it represents an interspecific hybrid and not a species

? **Inexact Numeric Rank**—Denotes inexact numeric rank

C **Captive or Cultivated Only**—Species at present is extant only in captivity or cultivation, or as a reintroduced population not yet established

A **Accidental**—Species is accidental or casual in Montana, in other words, infrequent and outside usual range. Includes species (usually birds or butterflies) recorded once or only a few times at a location. A few of these species may have bred on the one or two occasions they were recorded

Z **Zero Occurrences**—Species is present but lacking practical conservation concern in Montana because there are no definable occurrences, although the taxon is native and appears regularly in Montana

P **Potential**—Potential that species occurs in Montana but no extant or historic occurrences are accepted

R **Reported**—Species reported in Montana but without a basis for either accepting or rejecting the report, or the report not yet reviewed locally. Some of these are very recent discoveries for which the program has not yet received first-hand information; others are old, obscure reports

SYN **Synonym**—Species reported as occurring in Montana, but the Montana Natural Heritage Program does not recognize the taxon; therefore the species is not assigned a rank

* A rank has been assigned and is under review. Contact the Montana Natural Heritage Program for assigned rank

B **Breeding**—Rank refers to the breeding population of the species in Montana

Appendix B. Raw fish data and IBI metric calculations from Powder River sites.

Fish Species	Powder River #1		Powder River #2		Powder River #Moorhead		Powder River #3		Powder River #6		Powder River #5	
Channel Catfish	3		2		1		4		0		1	
Flathead Chub	38		22		28		40		52		59	
Goldeye	0		0		3		3		0		3	
Longnose Dace	1		1		3		0		2		1	
Plains Minnow	2		2		9		0		1		3	
Sand Shiner	4		2		3		8		15		37	
Stonecat	0		0		2		0		0		0	
Western Silvery Minnow	3		1		6		0		3		6	
Total # species	6		6		8		4		5		7	
Native Species	6		6		8		4		5		7	
Native Families	2		2		3		3		1		3	
Total Individuals	51		30		55		55		73		110	
# Minnow Species Thrive	4		4		5		2		4		5	
Proportion of tolerant individuals	0.00		0.00		0.00		0.00		0.00		0.00	
# Sucker + Catfish Species	1		1		2		1		0		1	
% Insectivorous Minnows	76.47		76.67		61.82		78.18		73.97		57.27	
# Benthic Invertivore Species	1		2		1		1		1		1	
% Litholphilic Spawners	9.80		10.00		20.00		20.00		23.29		37.27	
% Parental Care	5.88		6.67		1.82		7.27		0.00		0.91	
% Native to Montana	100.00		100.00		100.00		100.00		100.00		100.00	
# Long Lived Species	4		4		6		4		5		6	
Metrics	Adjust Value	Score	Adjust Value	Score	Adjust Value	Score	Adjust Value	Score	Adjust Value	Score	Adjust Value	Score
Number of Native Fish Species	4.86	27.00	4.86	27.00	6.86	38.11	2.86	15.89	3.86	21.44	5.86	32.55
Number of Native Fish Families	1.83	33.68	1.83	33.68	2.83	52.12	2.83	52.12	0.83	15.24	2.83	52.12
Proportion of tolerant individuals	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00	0.00	100.00
# of Sucker and Catfish Species	0.42	4.62	0.42	4.62	1.42	15.49	0.42	4.62	-0.58	-6.25	0.42	4.62
Proportion out of the Total Number of Fish That Were Insect eating Minnows	76.47	105.02	76.67	105.29	61.82	84.90	78.18	107.37	73.97	101.59	57.27	78.66
Total Number of Species That Prefer to Eat Insects That Live on the Stream Bottom	0.56	9.45	1.56	26.45	0.56	9.45	0.56	9.45	0.56	9.45	0.56	9.45
Proportion of the Total Number of Fish That Require Rocks to Lay Eggs	9.80	11.82	10.00	12.06	20.00	24.12	20.00	24.12	23.29	28.08	37.27	44.94
Proportion of the Total Number of Individuals That Do Not Require Rocks, But Have Parental Care of Eggs	5.88	93.31	6.67	92.42	1.82	97.93	7.27	91.73	0.00	100.00	0.91	98.97
Proportion of the Total Number of Fish Sampled That Are Native	100.00	100.04	100.00	100.04	100.00	100.04	100.00	100.04	100.00	100.04	100.00	100.04
Number of Long-Lived Native Species	3.31	33.92	3.31	33.92	5.31	54.41	3.31	33.92	4.31	44.16	5.31	54.41
Sum of Metrics		518.86		535.47		576.55		539.25		513.75		575.75
IBI Score		**51.89**		**53.55**		**57.66**		**53.92**		**51.38**		**57.57**

Appendix C. Macroinvertebrate taxa lists, abundance, and plains MMI calculations at each site.

Montana Bioassessment Report

Waterbody Name: Powder River@WYBorder
Benthic Sample 17984
Station ID: YLPOW1t1
Rep. 0
Reference
STORET Activity ID: P1-R500-M
Site Classification:
Collection Date: 07/26/2011
Latitude:
Collection Method: MAC-TR-500
Longitude:
Total Number of Individuals in Sample: 632

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
Coleoptera	Microcylloepus	Microcylloepus pusillus	15	5	CG	"CN/50%, BU/50%"
Coleoptera	Stenelmis	Stenelmis	3	5	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Cryptochironomus	2	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Robackia	1	7	CG/CF/PR	BU/CN/SP
Diptera	Hemerodromia	Hemerodromia	1	6	PR	SP
Diptera	Simuliidae	Simulium	244	6	CF	CN
Ephemeropter	Acentrella	Acentrella turbida	3	4	CG	"SW/10%, CN/90%"
Ephemeropter	Baetis	Baetis intercalaris	4	5	CG	"SW/10%, CN/90%"
Ephemeropter	Camelobaetidius	Camelobaetidius warreni	2	4	CG	"SW/10%, CN/90%"
Ephemeropter	Cercobrachys	Cercobrachys cree	3	4	CG	"SW/10%, CN/90%"
Ephemeropter	Ephoron	Ephoron album	6	2	CG	BU
Ephemeropter	Fallceon	Fallceon quilleri	17	5	CG	"SW/10%, CN/90%"
Ephemeropter	Isonychia	Isonychia campestris	16	2	CF	SW/CN
Ephemeropter	Leucrocuta	Leucrocuta	1	1	SC	CN
Ephemeropter	Plauditus	Plauditus punctiventris	1	5	SC	"SW/10%, CN/90%"
Ephemeropter	Traverella	Traverella albertana	149	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	6	4	CG	CN/SP
Haplotaxida	Oligochaeta	Tubificidae	4	8	CG	BU
Odonata	Gomphidae	Ophiogomphus severus	7	2	PR	BU
Plecoptera	Acroneuria	Acroneuria abnormis	18	0	PR	CN
Trichoptera	Brachycentrus	Brachycentrus occidentalis	20	1	CF	CN
Trichoptera	Cheumatopsyche	Cheumatopsyche	13	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche	28	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche morosa gr.	2	5	CF	CN
Trichoptera	Nectopsyche	Nectopsyche gracilis	11	2	SH	CM/SP/CN
Trichoptera	Oecetis	Oecetis	9	8	PR	CN/SP
TRICHOPTE	Potamyia	POTAMYIA FLAVA	16	4	CF	
Trichoptera	Mayatrichia	Mayatrichia ayama	2	5	CF	CN

Montana Bioassessment Report

Waterbody Name: Powder River@WYBorder
Benthic Sample 17985
Station ID: YLPOW1t1Q
Rep. 0
Reference
STORET Activity ID: P1-Q500-M
Site Classification:
Collection Date: 07/26/2011
Latitude:
Collection Method: MAC-RW-500
Longitude:
Total Number of Individuals in Sample: 561

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Anepeorus rusticus	2			
		Melanoides tuberculata	1			
Coleoptera	Microcylloepus	Microcylloepus pusillus	17	5	CG	"CN/50%, BU/50%"
Coleoptera	Stenelmis	Stenelmis	24	5	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Acalcarella	5	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cryptochironomus	2	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	2	7	CG/CF/PR	BU/CN/SP
Diptera	Hemerodromia	Hemerodromia	7	6	PR	SP
Diptera	Orthocladiinae	Parakiefferiella	2		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	151	6	CF	CN
Ephemeropter	Acentrella	Acentrella turbida	2	4	CG	"SW/10%, CN/90%"
Ephemeropter	Acerpenna	Acerpenna	3		SC	"SW/10%, CN/90%"
Ephemeropter	Baetis	Baetis intercalaris	7	5	CG	"SW/10%, CN/90%"
Ephemeropter	Baetis	Baetis tricaudatus	3	5	CG	"SW/10%, CN/90%"
Ephemeropter	Camelobaetidius	Camelobaetidius warreni	3	4	CG	"SW/10%, CN/90%"
Ephemeropter	Choroterpes	Choroterpes albiannulata	2	2	CG	CN/SP
Ephemeropter	Cercobrachys	Cercobrachys cree	5	4	CG	"SW/10%, CN/90%"
Ephemeropter	Ephoron	Ephoron album	1	2	CG	BU
Ephemeropter	Fallceon	Fallceon quilleri	14	5	CG	"SW/10%, CN/90%"
Ephemeropter	Isonychia	Isonychia campestris	22	2	CF	SW/CN
Ephemeropter	Leucrocuta	Leucrocuta	7	1	SC	CN
Ephemeropter	Raptoheptagenia	Raptoheptagenia cruentata	1		unk	CN
Ephemeropter	Rhithrogena	Rhithrogena	1	0	CG	CN
Ephemeropter	Traverella	Traverella albertana	178	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	20	4	CG	CN/SP
Hemiptera	Sialis	Sialis	1	4	PR	"CN,CM,BU"
Lepidoptera	Lepidoptera	Petrophila	1	7	SH	CM
Odonata	Gomphidae	Ophiogomphus severus	6	2	PR	BU
Plecoptera	Acroneuria	Acroneuria abnormis	15	0	PR	CN
Trichoptera	Brachycentrus	Brachycentrus occidentalis	3	1	CF	CN
Trichoptera	Cheumatopsyche	Cheumatopsyche	25	5	CF	CN
Trichoptera	Helicopsyche	Helicopsyche borealis	2	3	SC	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche	15	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche morosa gr.	3	5	CF	CN
Trichoptera	Nectopsyche	Nectopsyche gracilis	5	2	SH	CM/SP/CN
Trichoptera	Mayatrichia	Mayatrichia ayama	2	5	CF	CN
Veneroida	Pisidiidae	Pisidium	1	8	CF	BU

Montana Bioassessment Report

Waterbody Name: Powder River@drycreek
Benthic Sample 17986
Station ID: YLPOW2t1
Rep. 0
Reference
STORET Activity ID: P2-R500-M
Site Classification:
Collection Date: 07/26/2011
Latitude:
Collection Method: MAC-TR-500
Longitude:
Total Number of Individuals in Sample: 629

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
Coleoptera	Dubiraphia	Dubiraphia	4	6	SC/CG	"CN/50%, BU/50%"
Coleoptera	Microcylloepus	Microcylloepus pusillus	24	5	CG	"CN/50%, BU/50%"
Coleoptera	Stenelmis	Stenelmis	24	5	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Cladotanytarsus	5	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cryptochironomus	12	7	CG/CF/PR	BU/CN/SP
Diptera	Dicranota	Dicranota	5	0	PR	SP
Diptera	Hemerodromia	Hemerodromia	45	6	PR	SP
Diptera	Simuliidae	Simulium	76	6	CF	CN
Ephemeropter	Camelobaetidius	Camelobaetidius warreni	18	4	CG	"SW/10%, CN/90%"
Ephemeropter	Cercobrachys	Cercobrachys cree	4	4	CG	"SW/10%, CN/90%"
Ephemeropter	Ephoron	Ephoron album	62	2	CG	BU
Ephemeropter	Fallceon	Fallceon quilleri	108	5	CG	"SW/10%, CN/90%"
Ephemeropter	Isonychia	Isonychia campestris	6	2	CF	SW/CN
Ephemeropter	Leucrocuta	Leucrocuta	9	1	SC	CN
Ephemeropter	Plauditus	Plauditus punctiventris	9	5	SC	"SW/10%, CN/90%"
Ephemeropter	Traverella	Traverella albertana	52	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	27	4	CG	CN/SP
Haplotaxida	Oligochaeta	Tubificidae	15	8	CG	BU
Plecoptera	Acroneuria	Acroneuria abnormis	18	0	PR	CN
Trichoptera	Brachycentrus	Brachycentrus occidentalis	9	1	CF	CN
Trichoptera	Cheumatopsyche	Cheumatopsyche	18	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche	18	5	CF	CN
Trichoptera	Nectopsyche	Nectopsyche gracilis	8	2	SH	CM/SP/CN
Trichoptera	Oecetis	Oecetis	4	8	PR	CN/SP
TRICHOPTE	Potamyia	POTAMYIA FLAVA	45	4	CF	
Trichoptera	Mayatrichia	Mayatrichia ayama	4	5	CF	CN

Montana Bioassessment Report

Waterbody Name: Powder River@drycreek
Benthic Sample 17987
Station ID: YLPOW2t1Q
Rep. 0
Reference
STORET Activity ID: P2-Q500-M
Site Classification:
Collection Date: 07/26/2011
Latitude:
Collection Method: MAC-RW-500
Longitude:
Total Number of Individuals in Sample: 618

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Choroterpes albiannulata	6			
Basommatoph	Ferrissia	Ferrissia rivularis	2	6	SC	CN
Basommatoph	Lymnaeidae	Fossaria	2	6	CG	CN
Basommatoph	Physa_Physella	Physella acuta	8	8	CG	CN
Basommatoph	Planorbidae	Menetus	2	6	CG	CN
Coleoptera	Microcylloepus	Microcylloepus pusillus	10	5	CG	"CN/50%, BU/50%"
Coleoptera	Stenelmis	Stenelmis	4	5	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Acalcarella	24	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cryptochironomus	50	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	12	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Robackia	4	7	CG/CF/PR	BU/CN/SP
Diptera	Hemerodromia	Hemerodromia	6	6	PR	SP
Diptera	Orthocladiinae	Parakiefferiella	2		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	268	6	CF	CN
Ephemeropter	Acentrella	Acentrella turbida	8	4	CG	"SW/10%, CN/90%"
Ephemeropter	Baetis	Baetis tricaudatus	4	5	CG	"SW/10%, CN/90%"
Ephemeropter	Cercobrachys	Cercobrachys cree	6	4	CG	"SW/10%, CN/90%"
Ephemeropter	Ephoron	Ephoron album	18	2	CG	BU
Ephemeropter	Fallceon	Fallceon quilleri	16	5	CG	"SW/10%, CN/90%"
Ephemeropter	Hexagenia	Hexagenia limbata	2	6	CG	BU
Ephemeropter	Isonychia	Isonychia campestris	6	2	CF	SW/CN
Ephemeropter	Leucrocuta	Leucrocuta	5	1	SC	CN
Ephemeropter	Oligoneuriidae	Homoeoneuria alleni	4	2	unk	CN/BU
Ephemeropter	Raptoheptagenia	Raptoheptagenia cruentata	2		unk	CN
Ephemeropter	Rhithrogena	Rhithrogena	2	0	CG	CN
Ephemeropter	Traverella	Traverella albertana	70	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	18	4	CG	CN/SP
Odonata	Gomphidae	Ophiogomphus severus	4	2	PR	BU
Plecoptera	Acroneuria	Acroneuria abnormis	10	0	PR	CN
Trichoptera	Brachycentrus	Brachycentrus occidentalis	2	1	CF	CN
Trichoptera	Cheumatopsyche	Cheumatopsyche	14	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche confusa	4	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche morosa gr.	4	5	CF	CN
Trichoptera	Nectopsyche	Nectopsyche gracilis	19	2	SH	CM/SP/CN

Montana Bioassessment Report

Waterbody Name: Powder River@MooreheadBridge **Benthic Sample** 17994

Station ID: YLPOWMt1 **Rep.** 0

Reference **STORET Activity ID:** PM-T500-M

Site Classification: **Collection Date:** 07/26/2011

Latitude: **Collection Method:** MAC-TR-500

Longitude: **Total Number of Individuals in Sample:** 603

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Melanoides tuberculata	1			
Coleoptera	Microcylloepus	Microcylloepus pusillus	12	5	CG	"CN/50%, BU/50%"
Coleoptera	Stenelmis	Stenelmis	2	5	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Cryptochironomus	14	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	2	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Robackia	2	7	CG/CF/PR	BU/CN/SP
Diptera	Hemerodromia	Hemerodromia	10	6	PR	SP
Diptera	Simuliidae	Simulium	308	6	CF	CN
Ephemeropter	Acentrella	Acentrella turbida	1	4	CG	"SW/10%, CN/90%"
Ephemeropter	Camelobaetidius	Camelobaetidius warreni	8	4	CG	"SW/10%, CN/90%"
Ephemeropter	Ephoron	Ephoron album	7	2	CG	BU
Ephemeropter	Fallceon	Fallceon quilleri	14	5	CG	"SW/10%, CN/90%"
Ephemeropter	Isonychia	Isonychia campestris	2	2	CF	SW/CN
Ephemeropter	Leucrocuta	Leucrocuta	1	1	SC	CN
Ephemeropter	Pseudocloeon	Pseudocloeon	2	4	CG	"SW/10%, CN/90%"
Ephemeropter	Rhithrogena	Rhithrogena	3	0	CG	CN
Ephemeropter	Traverella	Traverella albertana	84	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	6	4	CG	CN/SP
Odonata	Gomphidae	Ophiogomphus severus	2	2	PR	BU
Plecoptera	Acroneuria	Acroneuria abnormis	8	0	PR	CN
Trichoptera	Brachycentrus	Brachycentrus occidentalis	12	1	CF	CN
Trichoptera	Cheumatopsyche	Cheumatopsyche	2	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche	12	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche morosa gr.	1	5	CF	CN
Trichoptera	Nectopsyche	Nectopsyche gracilis	50	2	SH	CM/SP/CN
Trichoptera	Oecetis	Oecetis	30	8	PR	CN/SP
TRICHOPTE	Potamyia	POTAMYIA FLAVA	6	4	CF	
Trombidiforme	Acarina	Hygrobates	1	5	PR	"SW/10%, CN/90%"

Montana Bioassessment Report

Waterbody Name: Powder River@MooreheadBridge **Benthic Sample** 17995

Station ID: YLPOWMt1Q **Rep.** 0

Reference **STORET Activity ID:** PM-Q500-M

Site Classification: **Collection Date:** 07/26/2011

Latitude: **Collection Method:** MAC-RW-500

Longitude: **Total Number of Individuals in Sample:** 607

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Dubiraphia vitatta	1			
Amphipoda	Gammarus	Gammarus	1	4	CG	"SW/50%, SP/50%"
Basommatoph	Lymnaeidae	Pseudosuccinea columella	1	6	CG	CN
Basommatoph	Physa_Physella	Physella acuta	1	8	CG	CN
Coleoptera	Stenelmis	Stenelmis	11	5	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Cryptochironomus	3	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	6	7	CG/CF/PR	BU/CN/SP
Diptera	Dicranota	Dicranota	3	0	PR	SP
Diptera	Hemerodromia	Hemerodromia	4	6	PR	SP
Diptera	Orthocladiinae	Orthocladius	1		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	306	6	CF	CN
Ephemeropter	Baetis	Baetis tricaudatus	1	5	CG	"SW/10%, CN/90%"
Ephemeropter	Ephoron	Ephoron album	26	2	CG	BU
Ephemeropter	Fallceon	Fallceon quilleri	11	5	CG	"SW/10%, CN/90%"
Ephemeropter	Heptagenia	Heptagenia	2	4	SC	CN
Ephemeropter	Isonychia	Isonychia campestris	18	2	CF	SW/CN
Ephemeropter	Leucrocuta	Leucrocuta	3	1	SC	CN
Ephemeropter	Oligoneuriidae	Homoeoneuria alleni	1	2	unk	CN/BU
Ephemeropter	Plauditus	Plauditus punctiventris	3	5	SC	"SW/10%, CN/90%"
Ephemeropter	Rhithrogena	Rhithrogena	3	0	CG	CN
Ephemeropter	Traverella	Traverella albertana	85	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	12	4	CG	CN/SP
Odonata	Gomphidae	Ophiogomphus severus	6	2	PR	BU
Odonata	Gomphidae	Stylurus	1	2	PR	BU
Plecoptera	Acroneuria	Acroneuria abnormis	11	0	PR	CN
Trichoptera	Brachycentrus	Brachycentrus occidentalis	2	1	CF	CN
Trichoptera	Cheumatopsyche	Cheumatopsyche	43	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche	20	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche morosa gr.	1	5	CF	CN
Trichoptera	Nectopsyche	Nectopsyche gracilis	19			
Trichoptera	Mayatrichia	Mayatrichia ayama	1	5	CF	CN

Montana Bioassessment Report

Waterbody Name: Powder River@Jenkins
Benthic Sample 17988
Station ID: YLPOW3t1
Rep. 0
Reference
STORET Activity ID: P3-T500-M
Site Classification:
Collection Date: 07/27/2011
Latitude:
Collection Method: MAC-TR-500
Longitude:
Total Number of Individuals in Sample: 558

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
Coleoptera	Microcylloepus	Microcylloepus pusillus	8	5	CG	"CN/50%, BU/50%"
Coleoptera	Stenelmis	Stenelmis	18	5	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Cryptochironomus	12	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	6	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Robackia	6	7	CG/CF/PR	BU/CN/SP
Diptera	Hemerodromia	Hemerodromia	10	6	PR	SP
Diptera	Simuliidae	Simulium	108	6	CF	CN
Ephemeropter	Camelobaetidius	Camelobaetidius warreni	2	4	CG	"SW/10%, CN/90%"
Ephemeropter	Ephoron	Ephoron album	36	2	CG	BU
Ephemeropter	Fallceon	Fallceon quilleri	24	5	CG	"SW/10%, CN/90%"
Ephemeropter	Heptagenia	Heptagenia	2	4	SC	CN
Ephemeropter	Isonychia	Isonychia campestris	24	2	CF	SW/CN
Ephemeropter	Leucrocuta	Leucrocuta	4	1	SC	CN
Ephemeropter	Plauditus	Plauditus punctiventris	2	5	SC	"SW/10%, CN/90%"
Ephemeropter	Raptoheptagenia	Raptoheptagenia cruentata	2		unk	CN
Ephemeropter	Traverella	Traverella albertana	110	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	22	4	CG	CN/SP
Haplotaxida	Oligochaeta	Tubificidae	2	8	CG	BU
Odonata	Gomphidae	Ophiogomphus severus	14	2	PR	BU
Plecoptera	Acroneuria	Acroneuria abnormis	20	0	PR	CN
Plecoptera	Isoperla	Isoperla	2	2	PR	CN
Trichoptera	Brachycentrus	Brachycentrus occidentalis	4	1	CF	CN
Trichoptera	Cheumatopsyche	Cheumatopsyche	12	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche	38	5	CF	CN
Trichoptera	Nectopsyche	Nectopsyche gracilis	38	2	SH	CM/SP/CN
Trichoptera	Oecetis	Oecetis	14	8	PR	CN/SP
TRICHOPTE	Potamyia	POTAMYIA FLAVA	12	4	CF	
Trichoptera	Mayatrichia	Mayatrichia ayama	6	5	CF	CN

Montana Bioassessment Report

Waterbody Name: Powder River@Jenkins
Benthic Sample 17989
Station ID: YLPOW3t1Q
Rep. 0
Reference
STORET Activity ID: P3-Q500-M
Site Classification:
Collection Date: 07/27/2011
Latitude:
Collection Method: MAC-RW-500
Longitude:
Total Number of Individuals in Sample: 385

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
Basommatoph	Lymnaeidae	Pseudosuccinea columella	1	6	CG	CN
Coleoptera	Stenelmis	Stenelmis	7	5	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Acalcarella	2	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cryptochironomus	12	7	CG/CF/PR	BU/CN/SP
Diptera	Hemerodromia	Hemerodromia	12	6	PR	SP
Diptera	Orthocladiinae	Orthocladius	3		CG/SC	SP/BU
Diptera	Orthocladiinae	Parakiefferiella	4		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	165	6	CF	CN
Ephemeropter	Baetis	Baetis intercalaris	3	5	CG	"SW/10%, CN/90%"
Ephemeropter	Camelobaetidius	Camelobaetidius warreni	4	4	CG	"SW/10%, CN/90%"
Ephemeropter	Ephoron	Ephoron album	23	2	CG	BU
Ephemeropter	Fallceon	Fallceon quilleri	16	5	CG	"SW/10%, CN/90%"
Ephemeropter	Isonychia	Isonychia campestris	2	2	CF	SW/CN
Ephemeropter	Leucrocuta	Leucrocuta	7	1	SC	CN
Ephemeropter	Oligoneuriidae	Homoeoneuria alleni	3	2	unk	CN/BU
Ephemeropter	Plauditus	Plauditus punctiventris	3	5	SC	"SW/10%, CN/90%"
Ephemeropter	Rhithrogena	Rhithrogena	1	0	CG	CN
Ephemeropter	Traverella	Traverella albertana	31	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	31	4	CG	CN/SP
Odonata	Gomphidae	Ophiogomphus severus	1	2	PR	BU
Plecoptera	Acroneuria	Acroneuria abnormis	8	0	PR	CN
Trichoptera	Brachycentrus	Brachycentrus occidentalis	3	1	CF	CN
Trichoptera	Cheumatopsyche	Cheumatopsyche	21	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche	1	5	CF	CN
Trichoptera	Nectopsyche	Nectopsyche	21	2	SH	CM/SP/CN

Montana Bioassessment Report

Waterbody Name: Powder River@RoughCreek
Benthic Sample 17990
Station ID: YLPOW5t1
Rep. 0
Reference
STORET Activity ID: P5-T500-M
Site Classification:
Collection Date: 07/27/2011
Latitude:
Collection Method: MAC-TR-500
Longitude:
Total Number of Individuals in Sample: 603

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
Coleoptera	Stenelmis	Stenelmis	6	5	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Cryptochironomus	6	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	3	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Robackia	12	7	CG/CF/PR	BU/CN/SP
Diptera	Hemerodromia	Hemerodromia	9	6	PR	SP
Diptera	Simuliidae	Simulium	66	6	CF	CN
Ephemeropter	Acerpenna	Acerpenna pygmaea	3		SC	"SW/10%, CN/90%"
Ephemeropter	Asioplax	Asioplax edmundsi	3		CG	CN/SP
Ephemeropter	Anepeorus	Anepeorus rusticus	1			
Ephemeropter	Camelobaetidius	Camelobaetidius warreni	3	4	CG	"SW/10%, CN/90%"
Ephemeropter	Cercobrachys	Cercobrachys cree	72	4	CG	"SW/10%, CN/90%"
Ephemeropter	Ephoron	Ephoron album	36	2	CG	BU
Ephemeropter	Fallceon	Fallceon quilleri	27	5	CG	"SW/10%, CN/90%"
Ephemeropter	Isonychia	Isonychia campestris	15	2	CF	SW/CN
Ephemeropter	Neochoroterpes	Neochoroterpes oklahoma	6	2	CG	CN/SP
Ephemeropter	Pseudocloeon	Pseudocloeon	6	4	CG	"SW/10%, CN/90%"
Ephemeropter	Traverella	Traverella albertana	233	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	3	4	CG	CN/SP
Haplotaxida	Oligochaeta	Tubificidae	6	8	CG	BU
Odonata	Gomphidae	Ophiogomphus severus	9	2	PR	BU
Plecoptera	Acroneuria	Acroneuria abnormis	42	0	PR	CN
Trichoptera	Brachycentrus	Brachycentrus occidentalis	3	1	CF	CN
Trichoptera	Nectopsyche	Nectopsyche gracilis	15	2	SH	CM/SP/CN
Trichoptera	Oecetis	Oecetis	3	8	PR	CN/SP
TRICHOPTE	Potamyia	POTAMYIA FLAVA	15	4	CF	

Montana Bioassessment Report

Waterbody Name: Powder River@RoughCreek
Benthic Sample 17991
Station ID: YLPOW5t1Q
Rep. 0
Reference
STORET Activity ID: P5-Q500-M
Site Classification:
Collection Date: 07/27/2011
Latitude:
Collection Method: MAC-RW-500
Longitude:
Total Number of Individuals in Sample: 394

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
Basommatoph	Physa_Physella	Physella acuta	1	8	CG	CN
Coleoptera	Stenelmis	Stenelmis	3	5	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Cryptochironomus	2	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	4	7	CG/CF/PR	BU/CN/SP
Diptera	Hemerodromia	Hemerodromia	4	6	PR	SP
Diptera	Orthocladiinae	Parakiefferiella	3		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	6	6	CF	CN
Ephemeropter	Ephoron	Ephoron album	39	2	CG	BU
Ephemeropter	Cercobrachys	Cercobrachys cree	29	4	CG	"SW/10%, CN/90%"
Ephemeropter	Fallceon	Fallceon quilleri	3	5	CG	"SW/10%, CN/90%"
Ephemeropter	Isonychia	Isonychia campestris	22	2	CF	SW/CN
Ephemeropter	Leucrocuta	Leucrocuta	2	1	SC	CN
Ephemeropter	Oligoneuriidae	Homoeoneuria alleni	23	2	unk	CN/BU
Ephemeropter	Traverella	Traverella albertana	166	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	8	4	CG	CN/SP
Odonata	Gomphidae	Ophiogomphus severus	4	2	PR	BU
Plecoptera	Acroneuria	Acroneuria abnormis	41	0	PR	CN
Trichoptera	Cheumatopsyche	Cheumatopsyche	22	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche	2	5	CF	CN
Trichoptera	Nectopsyche	Nectopsyche gracilis	8	2	SH	CM/SP/CN
Trichoptera	Mayatrichia	Mayatrichia ayama	1	5	CF	CN
Veneroida	Pisidiidae	Sphaerium	1	8	CF	BU

Montana Bioassessment Report

Waterbody Name: Powder River@buttermilk
Benthic Sample 17992
Station ID: YLPOW6t1
Rep. 0
Reference
STORET Activity ID: P6-T500-M
Site Classification:
Collection Date: 07/27/2011
Latitude:
Collection Method: MAC-TR-500
Longitude:
Total Number of Individuals in Sample: 631

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
		Melanoides tuberculata	1			
Diptera	Chironominae	Cryptochironomus	33	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	21	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Robackia	15	7	CG/CF/PR	BU/CN/SP
Diptera	Diamesinae	Potthastia	1	4	CG	sp
Diptera	Hemerodromia	Hemerodromia	27	6	PR	SP
Diptera	Simuliidae	Simulium	75	6	CF	CN
Ephemeropter	Baetis	Baetis intercalaris	6	5	CG	"SW/10%, CN/90%"
Ephemeropter	Cercobracys	Cercobrachys cree	12	4	CG	"SW/10%, CN/90%"
Ephemeropter	Ephoron	Ephoron album	12	2	CG	BU
Ephemeropter	Fallceon	Fallceon quilleri	21	5	CG	"SW/10%, CN/90%"
Ephemeropter	Heptagenia	Heptagenia	3	4	SC	CN
Ephemeropter	Isonychia	Isonychia campestris	3	2	CF	SW/CN
Ephemeropter	Leucrocuta	Leucrocuta	3	1	SC	CN
Ephemeropter	Plauditus	Plauditus punctiventris	3	5	SC	"SW/10%, CN/90%"
Ephemeropter	Pseudocloeon	Pseudocloeon	36	4	CG	"SW/10%, CN/90%"
Ephemeropter	Traverella	Traverella albertana	298	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	3	4	CG	CN/SP
Plecoptera	Acroneuria	Acroneuria abnormis	24	0	PR	CN
Plecoptera	Isoperla	Isoperla	6	2	PR	CN
Trichoptera	Cheumatopsyche	Cheumatopsyche	3	5	CF	CN
Trichoptera	Nectopsyche	Nectopsyche gracilis	15	2	SH	CM/SP/CN
Trichoptera	Oecetis	Oecetis	1	8	PR	CN/SP
Trichopte	Potamyia	Potamyia flava	6	4	CF	
Veneroida	Pisidiidae	Sphaerium	3	8	CF	BU

Montana Bioassessment Report

Waterbody Name: Powder River@buttermilk
Benthic Sample 17993
Station ID: YLPOW6t1Q
Rep. 0
Reference
STORET Activity ID: P6-Q500-M
Site Classification:
Collection Date: 07/27/2011
Latitude:
Collection Method: MAC-RW-500
Longitude:
Total Number of Individuals in Sample: 603

Sample Taxa List

Order:	*OTU name:*	*FinalID:*	*Individuals*	*Tol Val:*	*FFG:*	*Habit:*
Coleoptera	Microcylloepus	Microcylloepus pusillus	1	5	CG	"CN/50%, BU/50%"
Coleoptera	Stenelmis	Stenelmis	4	5	SC/CG	"CN/50%, BU/50%"
Diptera	Chironominae	Cladotanytarsus	1	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Cryptochironomus	14	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Polypedilum	12	7	CG/CF/PR	BU/CN/SP
Diptera	Chironominae	Robackia	11	7	CG/CF/PR	BU/CN/SP
Diptera	Hemerodromia	Hemerodromia	7	6	PR	SP
Diptera	Orthocladiinae	Parakiefferiella	11		CG/SC	SP/BU
Diptera	Simuliidae	Simulium	65	6	CF	CN
Ephemeropter	Baetis	Baetis tricaudatus	1	5	CG	"SW/10%, CN/90%"
Ephemeropter	Camelobaetidius	Camelobaetidius warreni	3	4	CG	"SW/10%, CN/90%"
Ephemeropter	Cercobracys	Cercobrachys cree	46	4	CG	"SW/10%, CN/90%"
Ephemeropter	Ephoron	Ephoron album	43	2	CG	BU
Ephemeropter	Fallceon	Fallceon quilleri	27	5	CG	"SW/10%, CN/90%"
Ephemeropter	Isonychia	Isonychia campestris	21	2	CF	SW/CN
Ephemeropter	Leucrocuta	Leucrocuta	3	1	SC	CN
Ephemeropter	Oligoneuriidae	Homoeoneuria alleni	19	2	unk	CN/BU
Ephemeropter	Plauditus	Plauditus punctiventris	1	5	SC	"SW/10%, CN/90%"
Ephemeropter	Raptoheptagenia	Raptoheptagenia cruentata	3		unk	CN
Ephemeropter	Rhithrogena	Rhithrogena	1	0	CG	CN
Ephemeropter	Traverella	Traverella albertana	145	2	CF	CN
Ephemeropter	Tricorythodes	Tricorythodes minutus	41	4	CG	CN/SP
Odonata	Gomphidae	Ophiogomphus severus	3	2	PR	BU
Odonata	Gomphidae	Stylurus	1	2	PR	BU
Plecoptera	Acroneuria	Acroneuria abnormis	23	0	PR	CN
Trichoptera	Cheumatopsyche	Cheumatopsyche	41	5	CF	CN
Trichoptera	Hydropsyche_Cerato	Hydropsyche	10	5	CF	CN
Trichoptera	Nectopsyche	Nectopsyche gracilis	45	2	SH	CM/SP/CN